Composition and structure of the meteoritic macromolecule: A source of complex organics on the early Earth

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Chondritic meteorites and interplanetary dust particles (IDPs) were a source of complex organic material on the early Earth. L enantiomer excesses in meteoritic amino acids has led to suggestions that this exogenous material played a role in the origin of life.

The majority of the organic material in chondrites is present as an insoluble, macromolecular material (IMM). The IMM's isotopic composition and IR spectrum suggests a direct link to refractory organic material in the diffuse interstellar medium. If the IMM played a role in the origin of life on Earth, its ubiquity in the Galaxy means it could be important to the development of life in other solar systems. Its composition also resembles that of the refractory organic matter in comet Halley dust.

IDPs may contain largely pristine IMM. In chondrites, aqueous alteration and thermal metamorphism modified the IMM to varying degrees. Many of the soluble organic compounds in chondrites may be alteration products of the IMM. Terrestrial weathering today rapidly breaks down the IMM. Weathering of the IMM on the early Earth may have been a more important source of complex soluble organics than those delivered directly by meteorites.

To understand the origin, chemistry and structure of the IMM, how it weathers and to quantify microanalytic techniques for STARDUST sample analysis, we have been conducting a multidisciplinary (NMR, XANES, XPS, EA and GC-MS) study of IMM. We will present our results for 32 chondrites, which reveal a complex functional group chemistry and behavior during aqueous alteration and metamorphism.